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**From:** Grange, Gabrielle Fenix [Gabrielle.Grange@doh.hawaii.gov]  
**Sent:** 2/20/2018 12:02:22 AM  
**To:** Fukumoto, Janice L CIV NAVFAC HI, EV3 [janice.fukumoto@navy.mil]; TU, LYNDSEY [Tu.Lyndsey@epa.gov]; Linder, Steven [Linder.Steven@epa.gov]; Ichinotsubo, Lene K [lene.ichinotsubo@doh.hawaii.gov]  
**CC:** g.d.beckett [g.d.beckett@aquiver.com]; JOHNSON, JEFF [JEFF.JOHNSON@aecom.com]; Saguibo, Tracy-Joy I CIV NAVFAC HI, OPHE3 [tracyjoy.saguibo@navy.mil]  
**Subject:** Re: Petrographic Test Info

Thanks Janice,

I will discuss with EPA and figure out what works on our side as well to facilitate discussions and technical interaction with minimal time delays, while keeping the AOC parties in the loop. The goal is to move technical interaction earlier in investigation processes, rather than providing comments after project decisions by the Navy have been carried through to a draft work product.

In the case of the petrographic analyses, G.D. expresses it well below:

"So, while I support these petrophysical evaluations in principle, I would like to understand more about the selection process, how these and other limitations will be considered, and what the intended final use(s) of these data will be. The two tests below are only a small component of the total number of parameters affecting LNAPL transport, so I would also like to know how those other parameters are being developed and considered".

Fenix

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**From:** Fukumoto, Janice L CIV NAVFAC HI, EV3 <janice.fukumoto@navy.mil>  
**Sent:** Thursday, February 15, 2018 5:06 PM  
**To:** Grange, Gabrielle Fenix; TU, LYNDSEY  
**Cc:** g.d.beckett; JOHNSON, JEFF; Kronen, John; Saguibo, Tracy-Joy I CIV NAVFAC HI, OPHE3  
**Subject:** RE: Petrographic Test Info

Hi Fenix,

I would like the flow of the information, and agree that time is of the essence. I would like to there to be discussions among our contractors to help the project move quicker and provide better understanding of technical objectives/issues. However, our contractors cannot represent the Navy in project-specific discussions. I think it would be acceptable to have the discussion among our contractors as long as Tracy (or another Navy-designated project representative) is on the line with them. I would encourage this!

I realize that at this point what is proposed is a discussion on methods. The natural and most beneficial portion of the discussion will be how the methods will be applied to this project. It would be best to allow the discussion to continue to how to apply the testing method to the project and would be more efficient to complete the discussion at that time. So this is why I would propose that we have a Navy representative on the line so the discussion can move quickly to project specific issues and gain better understanding of technical objective/issues of all parties.

I also see it appropriate with email communication between the contractors with Tracy or myself being copied on the email.

Thanks for the information and supporting a more proactive means to gain better understanding of technical objectives/issues of the parties.

VR, Janice Fukumoto, NAVFAC HI EV3, Environmental Restoration Program Manager, janice.fukumoto@navy.mil , (808) 471-3865

-----Original Message-----

From: Grange, Gabrielle Fenix [<mailto:Gabrielle.Grange@doh.hawaii.gov>]

Sent: Thursday, February 15, 2018 3:52 PM

To: Saguibo, Tracy-Joy I CIV NAVFAC HI, OPHE3

Cc: Fukumoto, Janice L CIV NAVFAC HI, EV3; TU, LYNDSEY; g.d.beckett

Subject: [Non-DoD Source] FW: Petrographic Test Info

Aloha Tracy,

In the spirit of opening technical dialogues, and given that time is of the essence with respect to the petrographic tests underway, I'd like to share G.D.'s thoughts on your response below. My impression at the SWMWG meeting from Jeff was that Jack would reach out to G.D directly to discuss the issue. Please forward to Jack Kronen and perhaps we could allow them to speak directly to address G.D's questions and understand his concerns before the tests are completed. The key items to resolve are having a shared understanding of how the data will be used, and discussing the limitations of the data generated in the larger process of evaluating LNAPL transport.

Thanks,

Fenix Grange, M.S.

Program Manager

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From: G D Beckett [<mailto:g.d.beckett@aquiver.com>]  
Sent: Thursday, February 15, 2018 3:26 PM  
To: Grange, Gabrielle Fenix <Gabrielle.Grange@doh.hawaii.gov>  
Subject: Re: Petrographic Test Info

Hi Fenix,

This would be my response to Tracy's note & attachment:

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Tracy,

Thank you for the summary and SOP. I am quite familiar with Core Lab and they typically do good work. You may know that I am the primary author of the API LNAPL parameters data base, and that work (along with extensive site applications) definitely provided some surprising insights into the potential limitations of petrophysical data.

My thoughts and potential concerns are related to several aspects of the petrophysical testing program. The first is the sample selection process and the criteria used. For instance, one of the more important features to test in this setting are fractures &/or bedding planes, particularly those with a high probability of interconnectivity and large apertures; Aa clinker zones have some similar discrete variability. These features are of course difficult to sample and retain; are we looking at those features as part of this testing? The paths of least resistance to LNAPL flow are the most critical to inform potential transport conditions. Measurements of the rock matrix characteristics are relatively unimportant because LNAPL will not intrude into that pore space under most release conditions.

Second, lab testing is often non-conservative unless the testing conditions are carefully considered to reflect the field conditions expected. For instance, the attached Figure shows that residual saturation is a function of pressure/saturation history. So if cores are artificially saturated with oil before testing, then one typically finds results that are greater than suggested field values (e.g., compare to field TPH &/or native state saturations in the vadose zone). If I'm recalling correctly, I think you've already observed this issue in that existing lab permeability results that are orders of magnitude lower than field-based ranges.

Capillary centrifuge testing methods, as will be used here, have come under suspicion because those results conflict with other well-documented results. As one example, the API LNAPL parameters database directly conflicts with other well-documented multiphase parameter measurements from the US Salinity Lab and other sources. Nearly all the samples in the API database were tested using centrifuge methods. The residual saturations derived from centrifuge testing are typically much larger than observed in field measurements and other literature values. In short, while these data can be

informative with respect to trends, they are not likely trustworthy as direct inputs to models, etc. For instance, at Honolulu Harbor, all 2-phase samples tested were at or below residual saturation and 3-phase values did not show a significant mobile fraction in most samples. In stark contrast to those test results, there is a large LNAPL plume with free-phase product in many observation wells that respond to baildown tests in ways not consistent with lab data. Product cannot flow if its below residual, so obviously in this example and many others, the lab data were not representative of field conditions and they were non-conservative (indicating product immobility and high residual saturations where in fact that was not so). Another challenge at Red Hill is we don't have many field data points with which to compare and validate lab results.

So, while I support these petrophysical evaluations in principle, I would like to understand more about the selection process, how these and other limitations will be considered, and what the intended final use(s) of these data will be. The two tests below are only a small component of the total number of parameters affecting LNAPL transport, so I would also like to know how those other parameters are being developed and considered.

Best regards, and thank you for the assistance!

G.D. Beckett, RG, CHg

Principal Hydrogeologist

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>>> Saguibo, Tracy-Joy I CIV NAVFAC HI, OPHE3<tracyjoy.saguibo@navy.mil>

>>> 2/14/2018 6:55 PM >>>

Hi Gary,

In response to your inquiry made during the last Groundwater Modeling Working Group meeting on February 12, please see below and attached for information on the petrographic testing being conducted for Red Hill.

A SOP for the two petrographic methods currently being using is attached. These petrographic testing methods are also

described in the Monitoring Well Installation Work Plan Addendum 02 derivative deliverable submitted on August 25, 2017.

To date, twenty-three (23) subsamples have been drilled from the core sections at the lab. Basic porosity and permeability properties have been run. Currently, samples are going through a baseline saturation process to establish initial saturations prior to testing.

Below is a brief summary of the two methods that are being used to assess LNAPL mobility:

. Mobility Group - Centrifuge Method, ASTM D425M : Applied centrifugal force at one speed (pressure) up to 1000G, confining stress and temperature to demonstrate product mobility; includes initial saturations, residual saturations by Dean-Stark, total porosity, grain and dry bulk density. Note that according to the lab, the ASTM method described is a starting point and can be modified, as necessary. That is, this study can be assessed at a number of centrifugal force speeds (pressures).

. Mobility Group - Water Drive Method, API RP40: Sample driven to final (residual) saturation by water/NAPL displacement. Final saturations are derived by Dean-Stark extraction. Includes initial saturations, total porosity, bulk & grain density.

Please let me know if you have further questions/issues; and if so, we can certainly schedule a day/time to discuss further.

Thanks!

V/R,  
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